Editorial - Assessing the uneven global distribution of readership, submissions and publications in applied ecology: Obvious problems without obvious solutions

Martin A. Nuñez[1] | Jos Barlow[2] | Marc Cadotte[3] | Kirsty Lucas[4] | Erika Newton[4] | Nathalie Pettorelli[5] | Philip A. Stephens[6]

[1*]Grupo de Ecología de Invasiones, INIBIOMA, CONICET – Universidad Nacional del Comahue, Bariloche, Argentina; nunezm@gmail.com;

[2]Lancaster Environment Centre, Conservation Ecology Group, Lancaster University, Lancaster, UK;

[3]Department of Biological Sciences, University of Toronto, Scarborough, Ontario, Canada;

[4]British Ecological Society, Charles Darwin House, London, UK;

[5]Zoological Society of London, Institute of Zoology, London, UK and

[6]Conservation Ecology Group, Department of Biosciences, Durham University, Durham, UK

*** Address for correspondence**

1 | ASSESSING THE GLOBAL DISTRIBUTION OF APPLIED ECOLOGY

What do Colombia, Indonesia, and Papua New Guinea have in common? Not only are they among the most biodiverse countries in the world, they also face a suite of environmental problems relating to land-use intensification, climate change, and wildlife management. Yet, at the same time, their capacity to respond to these issues remains weak; a weakness that is exacerbated by a deficit of the scientific research needed to guide policy and application (Barlow et al., 2018). A lack of locally developed applied ecological research may inhibit the identification of novel solutions to coupled socioecological problems such as the conservation of biodiversity and sustainable food production.

Here, we explore the global distribution of applied ecological research in more detail, through the lens of *Journal of Applied Ecology*'s submission, acceptance, and readership information from 2015 to 2017. We are specifically interested in assessing where research originates, whether the distribution of submissions, acceptance, and readership differs between the countries from which manuscripts originate, and whether there are strong country-level drivers of submission rates that can help to highlight potential solutions.

For submissions and publications in *Journal of Applied Ecology*, we analysed geographical submission patterns using the corresponding author's country of occupation for more than 3,000 articles submitted to the journal between 2015 and 2017. Corresponding author location is a robust measure of the primary location in which research was conducted. For example, an analysis of 3,000 manuscripts submitted to *Journal of Applied Ecology* showed that, in 98% of cases, an assessment of the country in which the research was conducted would be unaffected by whether the first or corresponding author's address was used. Thus, the following analyses are not sensitive to whether we consider the first or corresponding author. We use article access data to explore readership patterns across countries and interpret access data as a rough proxy for the demand for applied ecological science. We do, however, accept that other factors, such as open access status, and availability of papers on unlicensed platforms might affect the relationship between access data and demand for applied ecological science.

Using generalized linear models with (owing to the overdispersed nature of the data) a Quasi-Poisson distribution, we explored the impact on variation in submission rates, acceptance rates, and readership attributable to the following country-level indices: (a) GDPppp (gross domestic product, purchasing power parity); (b) percent of the GDP invested in research; (c) Social Progress Index (SPI, data from the NGO Social Progress Imperative); (d) total population size; and (e) the proportion of English speakers. Our choice of country-level indices is underpinned by the following hypotheses: (a) economic growth relates positively to the valuation and production of applied ecological research; (b) countries that invest more in research are more likely to produce and read applied ecological research; (c) social progress relates positively to research production and valuation; (d) all else being equal, more populated countries will have a greater number of people reading applied ecological research; (e) people in countries with an official language that is not English are less likely to read and produce applied ecological research in English-language journals. Data on the prevalence of English speaking were obtained from Amano and Sutherland (2013). We used data from the World Bank (UNESCO Institute for Statistics, 2018) for the other variables, including their list of countries. Highly correlated explanatory variables were excluded from the final model. Specifically, population size was excluded because it was highly correlated ($r = 0.81$) with GDPppp, and the Social Progress Index was not considered further since it was highly correlated with both investment in research and development ($r = 0.68$) and the proportion of English speakers ($r = 0.52$). Finally, we compared our publication data with those for the entire field of ecology (data from Scimago in the "Ecology" category, consisting of 346 journals in 2016) to determine if the patterns observed for *Journal of Applied Ecology* are unique or part of a more general trend.

2 | THE GEOGRAPHIC DISTRIBUTION OF SUBMISSIONS, ACCEPTANCE, AND READERSHIP

2.1 | Regional overview

The geographic distribution of articles submitted to or published in *Journal of Applied Ecology* is highly uneven. Europe, North America, and Oceania (largely driven by Australia) are prominent, with Asia, Africa, and Latin America sharing a much smaller proportion of submitted and accepted manuscripts (Figure 1). This uneven pattern is exacerbated when the population sizes of these different regions are taken into account (Figure 2). The likelihood of acceptance is also highly variable; manuscripts submitted from Europe, North America, and Oceania appear to have a greater chance of acceptance than manuscripts from other regions. For example,

24% of papers submitted from Europe are ultimately published, while only 8% of papers from East Asia are successful (Figure 1). Interestingly, readership differences between countries show similar patterns to submission and acceptance patterns (Figure 2), indicating deeper journal engagement and perhaps broader patterns of applied ecological research.

2.2 | Country-level statistics

Regional differences in submissions, accepted articles, and readership are driven by just a few countries (Figure 3). Corresponding authors from just seven countries submit 60% of the manuscripts we evaluate— USA, UK, Australia, Canada, Germany, France and Spain. Authors from these seven countries publish 70% of our papers. The next 24 countries provide an additional 29% of our accepted papers (i.e., 31 countries publish 99% of our papers). Corresponding authors from the remaining 181 countries, which collectively represent more than 50% of the world's population, contribute just 1% of the papers we publish. Beyond some differences in the relative dominance of the most highly ranked countries, there is little discernible difference between the ranked abundance of submissions, accepted articles, or readership.

Relatively specialized journals, like *Journal of Applied Ecology*, might not be expected to reflect publication patterns in the broader discipline (Lebel & McLean, 2018). To determine if our journal has a unique publication pattern, we assessed the level of correlation between the number of papers we publish from different countries and the global number of publications in ecology (data from Scimago in the "Ecology" category with 346 journals in 2016) and found a significant positive correlation ($r = 0.78$, $p < 0.001$, $n = 193$). Furthermore, the geographic unevenness found in publications from journals across ecology broadly follows a similar trend to the geographic unevenness found in *Journal of Applied Ecology* (Figure 3).

Our analyses provide some important insights into the factors shaping the observed spatial variation in submission rates (Figure 4). The most important variable determining submission rates in our data is the proportion of English-speaking individuals within a nation's population. This result suggests that the language barrier is an important impediment to many authors (consistent with Amano, González-Varo, & Sutherland, 2016). Furthermore, the proportion of the GDP invested in research and development and the overall GDP both had significant explanatory power, highlighting the importance of investment in science, as well as overall economic development.

3 | INTERPRETING THE UNEQUAL GEOGRAPHIC DISTRIBUTION OF APPLIED ECOLOGY

Our analyses of the global distribution of submissions, acceptance and readership rates reveal some important issues for the field of applied ecology.

Many of the most significant environmental problems occur in regions that have very limited interaction with *Journal of Applied Ecology*—or the broader international discipline of ecology. While local-level applied ecological research and action are most likely taking place, this lack of interaction is cause for concern; international journals are important communication vehicles, enabling the dissemination of novel ideas and sharing of experiences, while facilitating the gradual improvement of methods. If applied ecology is to have global benefit, then global inclusion needs to be one of its central tenets.

If the lack of interaction with international journals is indicative of a lack of local science, then our results are even more alarming because the application of ecology often requires local involvement to tailor management recommendations appropriately. Despite the generality of many ecological processes, environmental issues are often context specific in terms of the consequences and magnitude of effects, or the viability of solutions under different cultural and economic realities. Thus, managers and policymakers might not have access to the relevant information to extrapolate applied management strategies from some regions to others. For example, most of our understanding of biodiversity ecosystem functioning relationships is from temperate systems and the theoretical and applied implications might have little relevance for the biodiverse tropics (Clarke, York, Rasheed, & Northfield, 2017). Species invasions provide another context in which less-developed countries might face challenges different to those faced by more developed countries (Nuñez & Pauchard, 2010; Zenni, Ziller, Pauchard, Rodriguez-Cabal, & Nuñez, 2017). Researchers from the Global South would be leading research that is pertinent to local environmental and sustainability issues, since some of the most urgent problems—and, more importantly—areas where solutions can have the greatest impact, might be in these regions (Nagendra, 2018).

Without the assessment of applied ecological problems and solutions from habitats around the world, our perception of both problems and solutions could be influenced by the disproportionate representation of a few sites. In arctic ecology, for example, published articles primarily originate from two sites: one in Sweden and one in the USA (Metcalfe et al., 2018). This is a potential problem, since these two highly influential sites might not be representative of the arctic more generally. For instance, sites that are warming faster might be under-represented in currently available field observations. Similar problems have been highlighted in other regions—for example, there are key geographical gaps in our knowledge of soil biota, including in the regions from which we receive few submissions (Cameron et al., 2018). Even attempts to collect relevant applied ecological data globally, such as the Forest Global Earth Observatory (ForestGEO: https://forestgeo.si.edu/) or the Nutrient Network (Nutnet: http://www.nutnet.umn.edu/), have noticeable geographic gaps, especially in some parts of Africa and from Eastern Europe to Central Asia.

Finally, it seems likely that the uneven distribution of submissions and readership does not reflect the geographical distribution of research locations. We have published more than 50 articles on Africa in 2015–2017 (for example, Barthold, Loveridge, Macdonald, Packer, & Colchero, 2016; Case & Staver, 2017; Kleinschroth, Healey, Sist, Mortier, & Gourlet-Fleury, 2016), despite publishing only 13 papers from corresponding authors based there. The engagement of researchers from Western Europe and North America working in the Global South is crucial, as it helps to facilitate research and build expertise, and moves research funds into places that desperately need it. Indeed, this is reflected in many national-level research funds, such as the UK's Global Challenges Research Fund or the international BiodivScen Action. Undertaken in the appropriate way, with genuine collaboration and co-design, these research efforts can help to inform local strategies and build longer term capacity where is it most needed. But often—and even with the best intentions—the priorities and research needs of scientists from developed nations may be very different from the applied ecology required to develop local solutions. So, while foreign researchers working in the Global South are potentially an important part of the solution, solution-orientated applied ecology requires leadership from local researchers, who will have the greatest knowledge of the local issues and the connections with local stakeholders (Hulme, 2011; Mammides et al., 2016).

4 | HOW CAN WE RECTIFY THE UNEVEN DISTRIBUTION OF PUBLICATIONS?

The problems underlying the uneven geographic distributions of publications in journals like *Journal of Applied Ecology* are complex, systemic, and multifaceted, and the solutions are neither obvious nor simple. Beyond *Journal of Applied Ecology*, our results highlight the importance of supporting long-term investment in research and development across the Global South and suggest that language remains a key barrier to greater participation from researchers across that region (Figure 4). They also reinforce calls for greater local inclusion and leadership of research (e.g., Barlow et al., 2018). We strongly believe that applied ecology should be truly global and supported by local leadership and inclusive authorship. While we are aware of the limited role a journal can play in the broader issues of inequality, we are also hopeful that implementing good practices can help propel global change. Here, we outline four ways in which *Journal of Applied Ecology* is working to help overcome some of the issues we mention. We recognize that these are only the first steps and, of course, we are always thinking of ways to tackle inequality. We welcome feedback from you, the global ecological community, as these are issues that can only be resolved together.

The first issue that our journal can help address is that of the unequal inclusion in editorial and reviewing processes. We have therefore run open calls for Senior and Associate Editor positions instead of relying on traditional routes of finding editors through personal recommendations and collaboration networks. Since 2016, one third of our new editors have been from historically under-represented regions. Increasing diversity in editorial board members can attract more manuscripts from unrepresented regions of the world, and opens the door to a more varied group of reviewers, potentially leading to an improved peer review process. Importantly, improving diversity can do more than just increase submissions; we believe that it has the potential to improve acceptance rates in the longer term. Low acceptance rates from some regions may arise from a multitude of factors, including the quality of the manuscripts submitted to the journal, the extent of awareness of the journal's scope, or the existence of explicit or subconscious biases that reduce acceptance rates for authors from certain regions or ethnic groups (McNutt, 2016). Suspected biases against authors from the Global South are difficult to prove (Gibbs, 1995), but can be minimized by having a more diverse editorial board. *Journal of Applied Ecology*, along with the other *British Ecological Society* (BES) journals, also actively raises reviewer and editor awareness of unconscious bias and provides unconscious bias training resources to its editors.

Second, to support early career scientists from underrepresented areas to develop their skills, our journal also provides editorial training for researchers from those areas, via our Associate Editor Mentoring Opportunity. This programme provides a globally unique chance for early career researchers to access important editorial

experience. In the long run, these experiences can help local researchers develop their research agenda by engaging with international networks (Rochmyaningsih, 2018) and become leaders that can inspire future generations of applied ecologists.

Third, the journal and the BES as a whole are committed to addressing issues in equality and diversity. One of the journals in the BES stable will soon be investigating whether the issue of unconscious bias could be addressed by different review processes. Moreover, the BES' Publications team runs workshops around the world and produces the Guides to Better Science series (https://www.britishecologicalsociety.org/publications/guides-to/), which is freely available online. The *Guide to Getting Published* has also been translated into Chinese and our aim is to further expand this series in both topics and translations. We hope that providing training and resources will increase our engagement with researchers in under-represented areas, and increase the likelihood of submission and publication success.

Finally, our analyses suggest that English can be a substantial barrier to publication, as the proportion of English speakers in a country has a stronger effect on readership, submission, and acceptance rates than either total GDPppp or percent of the GDP invested in research and development. Beyond the country-level effects, English publications can be a challenge for other groups in need of scientific information (e.g., practitioners), if individuals in those groups are unable to adequately read and comprehend them (Amano et al., 2016). To overcome the barrier for readers, since the start of 2018, we have been hosting translated abstracts of our papers into local languages alongside the published article. So far, we have hosted abstracts in eight different languages, including Spanish, Swahili, and Portuguese. On The Applied Ecologist's Blog, we also offer space for authors to write multilingual posts associated with their papers as a way to reach a wider audience and to ensure that research reaches the most important end users.

5 | CONCLUSIONS

For ecological sciences to have a global impact and help to improve wildlife status, ecosystem services delivery, economies, and livelihoods, there is a need to increase the representation of researchers based in the Global South and other under-represented regions such as Central Asia. Besides the fact that more developed regions have a greater representation in our publications, the almost complete lack of representation from certain regions is deeply concerning and a problem that does not have any simple solution. We hope that the strategies we are implementing will have a positive impact. Ultimately, to create change, the entire scientific community, as well as national and international funders, need to prioritize global inclusion.

REFERENCES

Amano, T., González-Varo, J. P., & Sutherland, W. J. (2016). Languages are still a major barrier to global science. *Plos Biology*, *14*, e2000933. Amano, T., & Sutherland, W. J. (2013). Four barriers to the global understanding of biodiversity conservation: Wealth, language, geographical location and security. *Proceedings of the Royal Society of London B*, *280*, 20122649. https://doi.org/10.1098/ rspb.2012.2649

Barlow, J., França, F., Gardner, T. A., Hicks, C. C., Lennox, G. D., Berenguer, E., ... Graham, N. A. J. (2018). The future of hyperdiverse tropical ecosystems. *Nature*, *559*, 517–526. https://doi.org/10.1038/s41586-018-0301-1

Barthold, J. A., Loveridge, A. J., Macdonald, D. W., Packer, C., & Colchero, F. (2016). Bayesian estimates of male and female African lion mortality for future use in population management. *Journal of Applied Ecology*, *53*, 295–304. https://doi. org/10.1111/1365-2664.12594

Cameron, E. K., Martins, I. S., Lavelle, P., Mathieu, J., Tedersoo, L., Gottschall, F., ... Eisenhauer, N. (2018). Global gaps in soil biodiversity data. *Nature Ecology & Evolution*, *2*, 1042–1043. https://doi. org/10.1038/s41559-018-0573-8

Case, M. F., & Staver, A. C. (2017). Fire prevents woody encroachment only at higher-than-historical frequencies in a South African savanna. *Journal of Applied Ecology*, *54*, 955–962. https://doi. org/10.1111/1365-2664.12805

Clarke, D. A., York, P. H., Rasheed, M. A., & Northfield, T. D. (2017). Does biodiversity–ecosystem function literature neglect tropical ecosystems? *Trends in Ecology & Evolution*, *32*, 320–323. https://doi. org/10.1016/j.tree.2017.02.012

Gibbs, W. W. (1995). Lost science in the third world. *Scientific American*, *273*, 92–99. https://doi.org/10.1038/scientificamerican0895-92 Hulme, P. E. (2011). Practitioner's perspectives: Introducing a different voice in applied ecology. *Journal of Applied Ecology*, *48*, 1–2. https:// doi.org/10.1111/j.1365-2664.2010.01938.x

Kleinschroth, F., Healey, J. R., Sist, P., Mortier, F., & Gourlet-Fleury, S. (2016). How persistent are the impacts of logging roads on Central African forest vegetation? *Journal of Applied Ecology*, *53*, 1127–1137. https://doi.org/10.1111/1365-2664.12661

Lebel, J., & McLean, R. (2018). A better measure of research from the global south. *Nature*, *559*, 23–26. https://doi.org/10.1038/ d41586-018-05581-4

Mammides, C., Goodale, U. M., Corlett, R. T., Chen, J., Bawa, K. S., Hariya, H., ... Goodale, E. (2016). Increasing geographic diversity in the international conservation literature: A stalled process? *Biological Conservation*, *198*, 78–83. https://doi.org/10.1016/j.biocon.2016.03.030

McNutt, M. (2016). Implicit bias. *Science*, *352*, 1035–1035. https://doi. org/10.1126/science.aag1695

Metcalfe, D. B., Hermans, T. D. G., Ahlstrand, J., Becker, M., Berggren, M., Björk, R. G, ... Abdi, A. M. (2018). Patchy field sampling biases understanding of climate change impacts across the Arctic. *Nature Ecology & Evolution*, *2*, 1443–1448. https://doi.org/10.1038/ s41559-018-0612-5

Nagendra, H. (2018). The global south is rich in sustainability lessons that students deserve to hear. *Nature*, *557*, 485–488. https://doi. org/10.1038/d41586-018-05210-0

Nuñez, M. A., & Pauchard, A. (2010). Biological invasions in developing and developed countries: Does one model fit all? *Biological Invasions*, *12*, 707–714. https://doi.org/10.1007/s10530-009-9517-1

Rochmyaningsih, D. (2018). Showcase scientists from the global south. *Nature*, *553(7688)*, 251–251.

UNESCO Institute for Statistics. (2018). Researchers in R&D (per million people) via The World Bank. Retrieved from https://data.worldbank. org/indicator/SP.POP.SCIE.RD.P6

Zenni, R. D., Ziller, S. R., Pauchard, A., Rodriguez-Cabal, M., & Nuñez, M. A. (2017). Invasion science in the developing world: A response to Ricciardi et al. *Trends in Ecology & Evolution*, *32*, 807–808. https://doi. org/10.1016/j.tree.2017.08.006

Figure legends

FIGURE 1 Percentage of the total number of submitted manuscripts (in blue) and published papers (in green) in different regions of the world between 2015 and 2017. Some regions, namely Europe, North America, and Oceania, are by far the largest contributors to *Journal of Applied Ecology*, while other areas rarely submit a manuscript. Chances of a paper being accepted vary notably also between regions. Circle size represents the total number of submissions and papers accepted. Source: https://commons. wikimedia.org/wiki/Maps_of_the_world#/ media/File:BlankMap-World-noborders.png

FIGURE 2 Global patterns of readership and papers published per million people in *Journal of Applied Ecology*. Some regions of the world with large populations (e.g., East Asia) publish relatively fewer papers than others with lower populations (e.g., North America). Oceania has a notably higher number of papers published per million people than Europe or North America.

FIGURE 3 Rank of countries in relation to the proportion of full text accessed (reads from our website), total submissions, and total number of papers accepted in *Journal of Applied Ecology* and all journals in *Ecology* (from Scimago).

FIGURE 4 Standardized coefficient (±*SE*) of the three variables found to be important in our generalized linear model analyses. The variables are proportion of English speakers per country (from Amano & Sutherland, 2013), percent of the GDP invested in research and development, and gross domestic product, purchasing power parity (GDPppp).

Figure 1

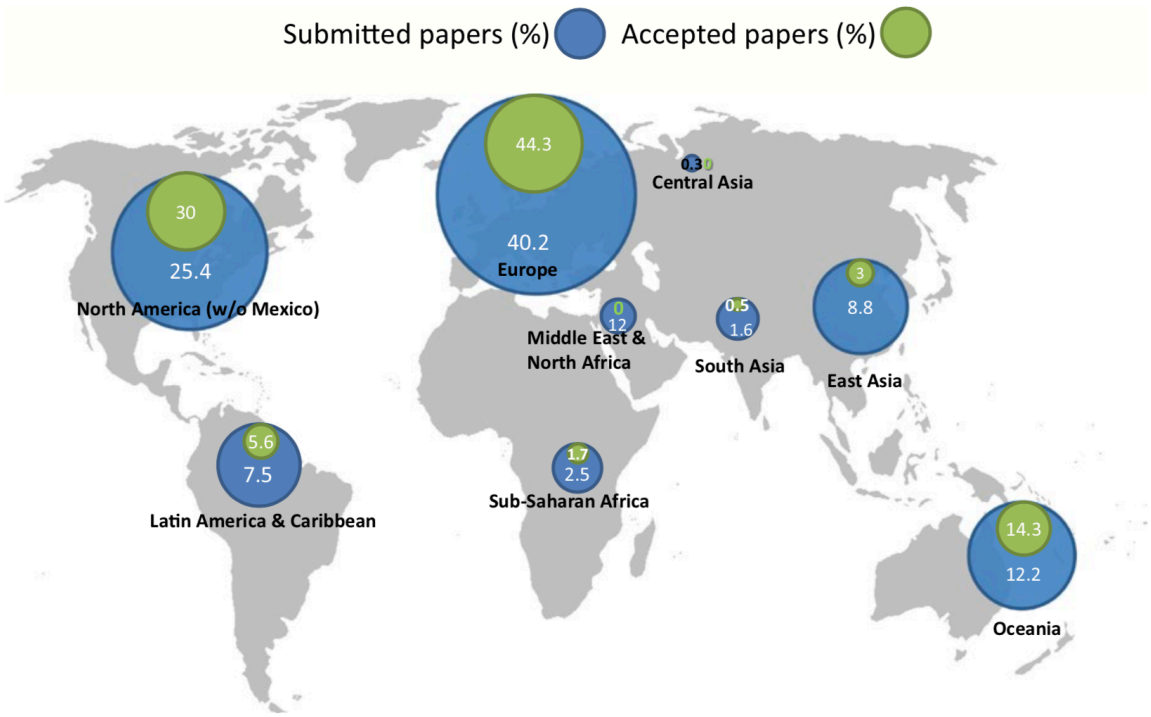

Submitted papers (%)
Accepted papers (%)
44.3
40.2
Europe
0.3
0
Central Asia
30
25.4
North America (w/o Mexico)
0
12
Middle East &
North Africa
0.5
1.6
South Asia
3
8.8
East Asia
5.6
7.5
Latin America & Caribbean
1.7
2.5
Sub-Saharan Africa
14.3
12.2
Oceania

Figure 2

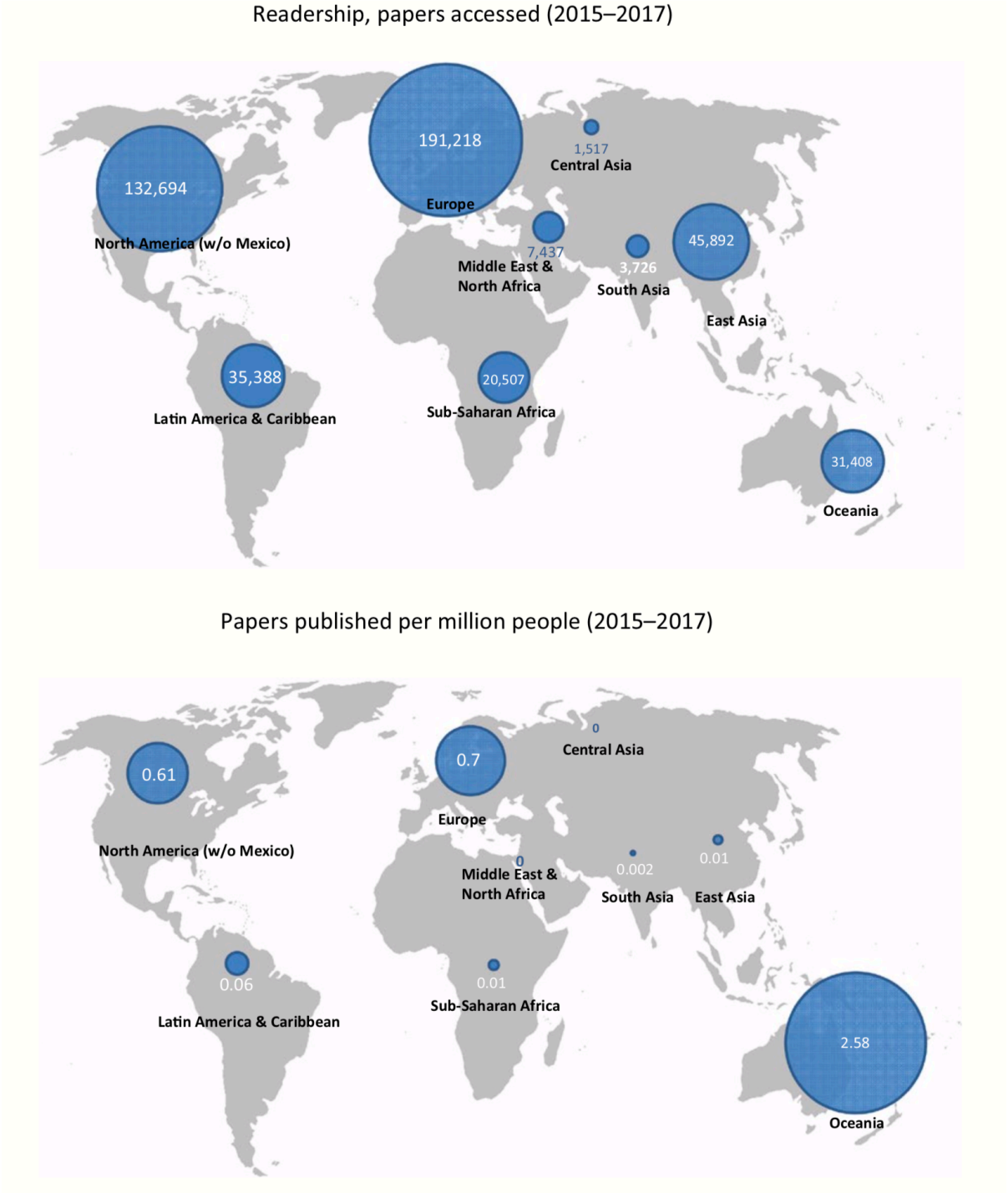

Readership, papers accessed (2015–2017)
132,694
North America (w/o Mexico)
191,218
Europe
1,517
Central Asia
7,437
Middle East & North Africa
3,726
South Asia
45,892
East Asia
35,388
Latin America & Caribbean
20,507
Sub-Saharan Africa
31,408
Oceania
Papers published per million people (2015–2017)
0.61
North America (w/o Mexico)
0.7
Europe
0
Central Asia
0
Middle East & North Africa
0.002
South Asia
0.01
East Asia
0.06
Latin America & Caribbean
0.01
Sub-Saharan Africa
2.58
Oceania

Figure 3

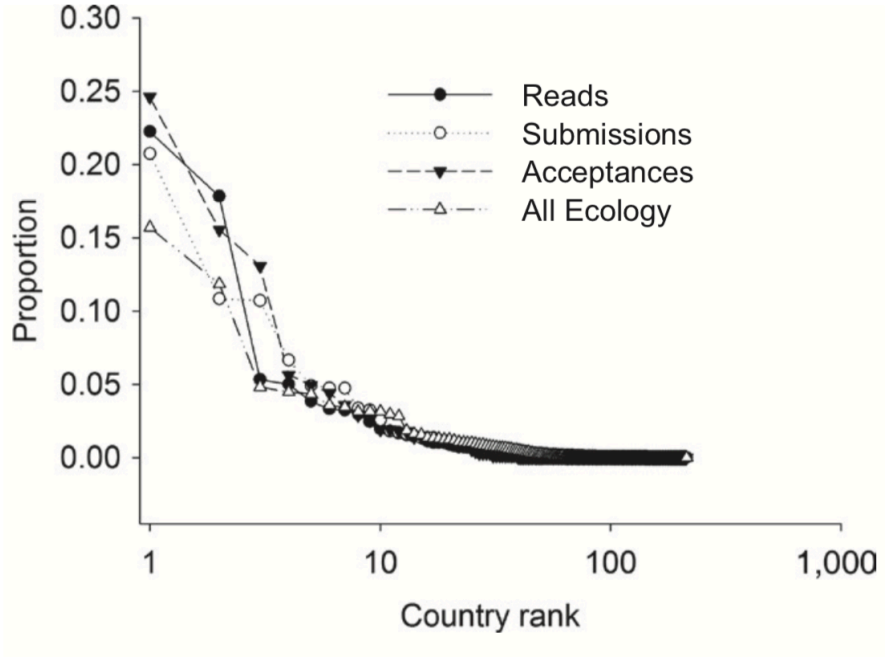
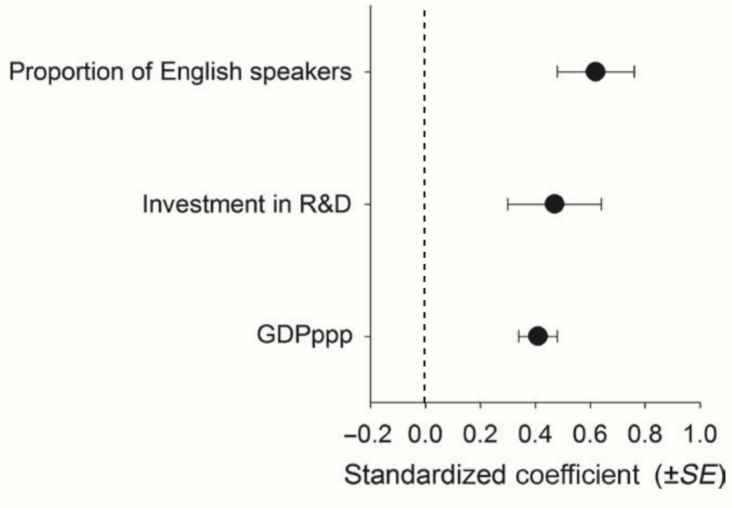

0.30
0.25
0.20
0.15
0.10
0.05
0.00
Proportion
Reads
Submissions
Acceptances
All Ecology
1
10
100
1,000
Country rank

Figure 4


Proportion of English speakers
Investment in R&D
GDPppp
–0.2 0.0 0.2 0.4 0.6 0.8 1.0
Standardized coefficient (±SE)